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Large Deformation of an Elastic Rod with Structural Anisotropy Subjected to Fluid Flow MASOUD HASSANI, NJUKI MUREITHI, FREDERICK GOSSELIN, Ecole Polytech de Montreal — In the present work, we seek to understand the fundamental mechanisms of three-dimensional reconfiguration of plants by studying the large deformation of a flexible rod in fluid flow. Flexible rods made of Polyurethane foam and reinforced with Nylon fibers are tested in a wind tunnel. The rods have bending-torsion coupling which induces a torsional deformation during asymmetric bending. A mathematical model is also developed by coupling the Kirchhoff rod theory with a semi-empirical drag formulation. Different alignments of the material frame with respect to the flow direction and a range of structural properties are considered to study their effect on the deformation of the flexible rod and its drag scaling. Results show that twisting causes the flexible rods to reorient and bend with the minimum bending rigidity. It is also found that the drag scaling of the rod in the large deformation regime is not affected by torsion. Finally, using a proper set of dimensionless numbers, the state of a bending and twisting rod is characterized as a beam undergoing a pure bending deformation.

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